CLINICAL RESEARCH

Temporal trends in prehospital management of ST-segment elevation myocardial infarction from 2002 to 2010 in Cote d’Or: Data from the RICO registry (obseRvatoire des Infarctus de Cote d’Or)

Évolution de la prise en charge préhospitalière des infarctus avec sus-décalage du segment ST entre 2002 et 2010 en Côte d’Or : données de l’observatoiRe des Infarctus du myocarde de Côte d’Or (RICO)

Esther Milojevitch a, Luc Lorgis b, Nicolas Falvo c, Philippe Buffet b, Laurent Boidron a, Gilles Dentan d, Christophe Avena a, Jean-Claude Beer b, Karim Boudenia a, Marianne Zeller e,* , Marc Freysz a, Yves Cottin b

a SAMU 21, Prehospital Care Department, Hôpital Général, Faculty of Medicine, University of Burgundy, Dijon, France
b Cardiology Department, University Hospital Bocage, Dijon, France
c Department of Internal Medicine and Clinical Immunology, University Hospital, Dijon, France
d Cardiology Department, Clinique de Fontaine, Fontaine-lès-Dijon, France
e Laboratory of Cardiometabolic Physiopathology and Pharmacology, Inserm U866, University of Burgundy, Dijon, France

Received 24 May 2012; received in revised form 7 August 2012; accepted 29 August 2012
Available online 9 November 2012

KEYWORDS
STEMI; Reperfusion;

Summary

Background. — Myocardial infarction with ST-segment elevation (STEMI) is a medical emergency requiring specific management, with the main aim of achieving reperfusion as quickly as possible.

Abbreviations: GP, general practitioner; HAS, Haute Autorité de Santé; pPCI, primary percutaneous coronary intervention; RICO, obseRvatoire des Infarctus de Côte d’Or; STMI, ST-segment elevation myocardial infarction.

* Corresponding author. Laboratory of Cardiometabolic Physiopathology and Pharmacology, Inserm U866, Faculty of Medicine, University of Burgundy, 7, boulevard Jeanne-d’Arc, 21079 Dijon, France.
E-mail address: marianne.zeller@u-bourgogne.fr (M. Zeller).

1875-2136/$ — see front matter © 2012 Elsevier Masson SAS. All rights reserved.
http://dx.doi.org/10.1016/j.acvd.2012.08.004
Introduction

Myocardial infarction, including ST-segment elevation myocardial infarction (STEMI), is one of the leading causes of morbi-mortality worldwide [1]. Management of STEMI presents a medical emergency, with the main objective being to urgently reopen the occluded artery, in order to minimize necrosis size and subsequent disabling complications. One of the prerequisites for timely and efficacious management is that the first medical contact be made early in case of suspected acute myocardial infarction [2,3].

In France, in patients with chest pain, optimal management recommended by the National Authority for Health (Haute Autorité de Santé [HAS]) since 2006 comprises a systematic call to the emergency medical system followed by intervention by a mobile intensive care unit from the Service mobile d’urgence et de réanimation with doctors on board, who perform an early prehospital electrocardiogram to enable direct admission to the catheterization laboratory within a time period that should not exceed 45 minutes from the time of first medical contact [4,5].

Since 2001, Côte d’Or, an eastern department of France, has had an ongoing registry (obseRvatoire des Infarctus de la Côte d’Or [RICO]) to record data, including time to treatment for all myocardial infarctions, for all patients hospitalized for an acute myocardial infarction in any of the coronary care units in the department.

Our study, based on the data from this registry, aimed to evaluate temporal trends in time to treatment in patients with STEMI between 2002 and 2010.

Methods

The study included all patients with a confirmed diagnosis of STEMI admitted to the coronary care units in the six participating centres (the general hospitals of Beaune, Châtillon-sur-Seine, Montbard and Semur-en-Auxois, the private clinic of Fontaine-lès-Dijon and the University Hospital...
Bocage, Dijon) between 1st January 2002 and 31st December 2010, and treated in one of the two centres equipped with interventional cardiology facilities (catheterization laboratory). For each patient, standardized data collection was performed using the RICO registry case report form.

For the purposes of this report, we analysed baseline demographic and clinical characteristics of the patients, times to treatment, the medical and paramedical staff involved in prehospital management, reperfusion strategies and the existence of any prior admissions to other hospitals for cardiovascular causes. Data on major in-hospital cardiac events, including cardiogenic shock, recurrent myocardial infarction and cardiovascular death, were collected. The study complied with the Declaration of Helsinki and was approved by the ethics committee of the Centre hospitalier universitaire de Dijon. Each patient gave written informed consent before participation.

Statistical analysis
Data recorded in the RICO case report form were transcribed into a dedicated computer programme to facilitate archiving and statistical analysis. All statistical analyses were performed using SPSS software, version 12.0 (IBM Corp., Armonk, NY, USA).

Quantitative data are described as mean ± standard deviation and qualitative data as number (percentage). For continuous variables, the normality of distribution was checked by the Kolmogorov–Smirnov test. We performed either the Kruskal–Wallis one-way analysis of variance by rank for non-normally distributed values or one-way analysis of variance for normally distributed values. Categorical data were compared using the χ² test, as appropriate. A two-sided P value of 0.05 was considered statistically significant.

Results
Between 1st January 2002 and 31st December 2010, 4114 patients were admitted for STEMI in the participating centres. The distribution of STEMs per year over the study period is shown in Fig. 1 (1162 women; 2952 men). Among these, 2387 were admitted directly to one of the two coronary referral centres equipped with angioplasty facilities, while the remaining 1727 were first admitted to a peripheral hospital.

First medical contact
Over the study period, the number of patients who made first medical contact with their local general practitioner (GP) decreased, with a corresponding increase in the number who contacted the emergency services by telephone (i.e. by dialling 15) as first medical contact. In 2002, 246 (57.1%) contacted the GP first versus 107 (24.8%) who dialled the emergency services, compared with 184 (34.2%) and 212 (39.4%), respectively, in 2010. In addition, 5 to 10% of patients called the fire brigade as first medical contact each year (by dialling 18). Other recipients of first calls included private practice cardiologists, hospital emergency rooms and hospital units other than the emergency department or the coronary care unit.

There was a significant difference in time to first medical contact according to age, with patients aged less than 50 years getting help on average 40 to 100 minutes earlier than patients aged over 50 years (P = 0.019). There were no differences in time to first medical contact according to sex, diabetes or history of myocardial infarction.

Time to reperfusion
The average time to reperfusion from first medical contact over the entire study period was 312 minutes (median 165 minutes). The time to treatment varied considerably depending on who was first contacted (GP, emergency services, fire brigade, etc.). Calling the emergency services (by dialling 15) as first medical contact significantly reduced the average time between the first call and reperfusion (218 minutes [median 120 minutes] compared with 397 minutes [median 225 minutes] when the GP was first to be contacted; P = 0.005). If the patient contacted the GP first but subsequently contacted the emergency services, the average time to reperfusion decreased to 283 minutes (median 180 minutes). The later the emergency services were contacted, the longer the time to reperfusion, with an average time to reperfusion of 482 minutes in patients who did not contact the emergency services at all.

Over the study period, the average time from onset of symptoms to first medical contact increased slightly, but not significantly, from 307 minutes in 2002 to 340 minutes in 2010, with some fluctuation over the study period.

![Figure 1](https://example.com/figure1.png)

**Figure 1.** Number of ST-segment elevation myocardial infarctions in the Observatoire des Infarctus de Côte d’Or (RICO) database per year (2002–2010).
Reperfusion therapy

In 2002, 151 (35%) STEMI patients underwent revascularization at the acute phase of STEMI by thrombolytic therapy, 100 (23.1%) underwent primary percutaneous coronary intervention (pPCI) and 181 (41.9%) had no reperfusion at all. The proportion of patients treated by pPCI increased over the study period and, since 2007, has exceeded the proportion treated by thrombolytic therapy. Accordingly, in 2010, 197 patients (36.7%) were treated by pPCI and 145 (27%) were treated by thrombolytic therapy. The number of patients without any reperfusion strategy decreased steadily over the study period, reaching 36.3% (n = 196) in 2010. The evolution of the types of reperfusion over the course of the study is shown in Fig. 2.

The average time between onset of symptoms and initiation of thrombolytic therapy decreased significantly, from 213 minutes (median 150 minutes) in 2002 to 143 minutes (median 120 minutes) in 2010 (P = 0.004). The average time to pPCI fluctuated over the study period, with an increase over the first few years of the study, a marked decrease between 2005 and 2006 and then a tendency towards an increase up to 2010. The time trends from symptom onset to treatment are shown in Fig. 3.

Overall, the average time from first medical contact to reperfusion decreased significantly over the study period, from 339 minutes in 2002 to 239 minutes in 2010 (P = 0.009). Temporal trends in time from onset of symptoms to first medical contact to reperfusion are shown in Fig. 4.

No reperfusion

The proportion of patients without any reperfusion strategy within the first 12 hours after onset of symptoms ranged from 35% to 43% over the study period. There was a significantly higher proportion of patients without reperfusion...
Temporal trends in STEMI prehospital management

Figure 4. Trends in average times from onset of symptoms (OS) and first medical contact (FMC) to reperfusion, from 2002 to 2010. pPCI: primary percutaneous coronary intervention.

among those who were first admitted to a peripheral hospital compared with among those admitted directly to a coronary referral centre with angioplasty facilities (P < 0.001).

Prognosis
In-hospital cardiac events analysis showed a trend towards a decline in the rates of cardiogenic shock (from 12% in 2002 to 7% in 2010), recurrent myocardial infarction (from 9% in 2002 to 3% in 2010) and mortality (from 8% in 2002 to 6% in 2010) (Fig. 5).

Discussion
Our large population-based study on STEMI patients at a departmental scale shows that over the 9-year study period, the pattern for seeking medical help at symptom onset has evolved considerably. The proportion of patients who made first medical contact with the emergency services by telephone (by dialling 15) increased by 60% (from 25% to 40%) and, in parallel, there was a significant reduction in time from first medical contact to reperfusion in STEMI patients. The French ‘Stent for Life’ registry previously recorded a similar rate of use of the emergency services in 2010, at 43.8% [4,6]. It has been established over the past decade that dialling 15 for the emergency services as the first point of contact in a medical emergency makes it possible to reduce time delays, and professional societies recommend dialling the emergency services number as the sole first medical contact [2,5,7–10]. However, although the proportion of patients dialling 15 as first medical contact has increased over the years, this number is still not high enough. Over the past decade in our region, we report an evolution in patient behaviour at symptom onset, characterized by a marked decrease in calls to the GP as first medical contact (~40%), in favour of increasing rates of emergency

Figure 5. Trends in hospital cardiac events, including cardiogenic shock, recurrent myocardial infarction (MI) and cardiovascular (CV) deaths, from 2002 to 2010.
number calls (+56%) at symptom onset, demonstrating that, nowadays, most patients dial the emergency number to seek medical assistance. These findings are in line with current data for the French part of the 'Stent for Life' initiative, which reported a very similar rate of dialling 15 (50%) (http://www.stentforlife.com/participating-countries/france). Hence, two national prevention campaigns were planned for 2011, dedicated to increasing the rate of use and promoting early contact with the emergency services by dialling 15 [4,6,7]. It will be interesting to investigate whether there is a corresponding increase in use over the coming years.

Despite this increase in the proportion of calls to the emergency services, the time delay between onset of symptoms and the patient’s first medical contact did not improve significantly over the course of the study, with a stable median time of around 60 minutes. Furthermore, median times from symptoms onset to first medical contact were similar for both sexes, although women tended to call slightly later than men. We also noted that older patients (aged over 50 years) tended to wait longer before making their first medical contact, which is consistent with previous reports [11–14].

Overall, we noted little change over the study period in times to treatment, from onset of symptoms to first medical contact and reperfusion. Indeed, the median time to admission remained stable over the study period, ranging from 180 to 200 minutes. However, the time to reperfusion was shorter in patients whose first contact was with the emergency services. In addition, the times to treatment appear to be somewhat longer in Cote d’Or than those reported in studies in the USA and Europe [11,13,14]. The geographic specificity of the region, with large undermedicalized rural zones and long distances between peripheral hospitals and centres equipped with catheterization laboratory facilities (up to 100 km), leading to long transport times, may explain this finding.

Reperfusion practices and prognosis

Since 2006, HAS has recommended pPCI as the first-line revascularization strategy in STEMI. Thrombolytic therapy remains a useful alternative, particularly when the time between first medical contact and start of pPCI is estimated to exceed 90 minutes and onset of symptoms occurred <12 hours previously. Regardless of the initial treatment strategy, transfer to a referral centre equipped with angioplasty facilities is recommended [5].

In the Cote d’Or department, we noted a considerable increase in the rate of pPCI between 2006 and 2007, with a parallel reduction in thrombolytic therapy. Since 2007, the proportion of patients treated by pPCI has exceeded the rate of thrombolysis (36.7% and 27%, respectively, in 2010). Similar findings were observed at national level [15]. The preference for pPCI over thrombolysis as a revascularization strategy has also been observed in most European studies, although the different cultural, geographical and health care system contexts lead to heterogeneity in distribution [15,16]. Indeed, even in our study, we noted some periodic peaks in the use of one or other technique, without any change in professional guidelines that might explain these brief changes in trends. Over the course of the study, we noted a persistent decrease in the rate of patients without any reperfusion strategy within the first 12 hours after onset of symptoms. However, this rate remained quite high in 2010, with 36.3% of our STEMI population not receiving any reperfusion therapy. This finding is in line with previous reports from the FAST-MI registry, which reported 40% of patients without any reperfusion strategy at the acute phase [17]. However, the rate of patients without reperfusion in our study is lower than the rate in the most recent FAST MI registry (2010), which reported only 16% [18]. In our study, however, STEMI patients were older, with longer prehospital time delays than in the nationwide registry. STEMI patients were not included if they were admitted to a peripheral centre, died before transfer or if a decision was made not to transfer them, thus leading to an underestimation of the proportion of non-reperfused patients from the peripheral centres. Indeed, patients who were transferred for PCI were highly selected from the peripheral hospitals, leading to a higher rate of revascularization among transferred patients.

Our data reveal that the time from onset of symptoms to reperfusion increased over the study period, as did the time from first medical contact to reperfusion when the patient was first admitted to a peripheral centre. For patients undergoing pPCI, there was a time delay of 180 minutes from onset of symptoms if the patient was not admitted directly to a PCI referral centre. These data confirm the findings of the “Stent for Life” study, which showed longer times to treatment for patients admitted to peripheral centres [4].

The geography of the Cote d’Or department and the location of the peripheral hospitals in relation to the two referral centres can likely explain the time delay for PCI when the first admission is to a peripheral centre. Indeed, transport times ranging from 25 to 70 minutes are required to travel from the peripheral hospital to the PCI referral centre. Transport by helicopter reduces these delays considerably but, naturally, this framework is not available for all patients and can only be used in certain weather conditions and during the day. Our data showed significant improvement in short-term prognosis over the past decade, in particular for cardiogenic shock or recurrent myocardial infarction, which were markedly reduced by almost 50% and 70%, respectively. These findings are in agreement with major registries reporting a decline in hospital major cardiac events over the past decade, including recurrent myocardial infarction and shock [19]. However, cardiovascular hospital mortality showed only a weaker insignificant trend towards reduction (−21%) from 2002 to 2010.

Strengths and limitations

This descriptive longitudinal study paints a portrait of the profile of patients with STEMI in the Cote d’Or department between 2002 and 2010. The database is an exhaustive registry that includes all patients admitted with STEMI in the participating centres. The study population is large (>4000 patients) and therefore can be considered as representative of the population of STEMI patients managed in a hospital setting. The extended duration of the study (9 years) makes it possible to follow the evolution of management patterns over time.

Conversely, because this study is observational we cannot draw any conclusions regarding cause–effect relationships
temporal in Chagnon, Philip concerning transferred characteristic and admitted were not included. This represents a bias, as any patients who died before being transferred or who were transferred to centres other than the two referral centres participating in the registry were not included.

Conclusion

Myocardial infarction with ST-segment elevation is a life-threatening medical emergency. Early contact with the emergency services is vital to ensure rapid management and early reperfusion. Although there was an increase in the number of patients who contacted the emergency services first by dialling 15, this proportion remains insufficient at roughly 50%. In addition, in 2010, patients did not call for medical help at symptom onset earlier than in 2002, reflecting a lack of awareness among the population of the life-threatening nature of myocardial infarction or the characteristic signs of the disease. However, our data show that in our department, the proportion of patients undergoing no reperfusion decreased steadily over the study period and the times to treatment generally improved.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

Acknowledgements

We wish to thank Anne Cécile Lagrost, Florence Bichat, Aline Chagnon and Julienne Berchoud for research assistance and Philip Bastable for English assistance. This work was supported by the University Hospital of Dijon, Association de cardiologie de Bourgogne, Conseil régional de Bourgogne and Fédération française de cardiologie, and by grants from the Agence régionale de santé de Bourgogne (ARS).

References